A Housing Energy Management Program Report

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HIGH EFFICIENCY RESIDENTIAL CONDENSING GAS FORCED AIR AND HIGH EFFICIENCY PULSE BOILERS FIELD EVALUATION - FINAL REPORT (PROJECT REPORT # 58)

Prepared for

ONTARIO MINISTRY OF MUNICIPAL AFFAIRS AND HOUSING
HOUSING RENOVATION AND ENERGY CONSERVATION UNIT

by

NORTHERN AND CENTRAL GAS CORPORATION LIMITED

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INTRODUCTION

The field evaluation of these installations were carried out from January, 1982 through to the May, 1983 heating season to generate the performance and operation data.

This report contains information on the results of the test site data and its comparison to existing equipment which promotes energy conservation.

INSTALLATIONS

For data dates pertaining to the installations, locations, type of heating equipment and monitoring set-up, please refer to "FIELD EVALUATION, INSTALLATION (INTERM) REPORT" dated January, 1983.

SITE READINGS AND RESULTS

3.1 North Bay - Site I

The test results for the period January, 1982 to April, 1983 shows that the High Efficiency Pulse Boiler used 1314.6 m^3 of natural gas through a period of 2343.7 degree days.

The average BTU content per m^3 is 35,300 BTU's at a cost of 21.4¢.

The aforementioned results from the test period shows that the High Efficiency Pulse Boiler used 19,802 BTU/Degree Day at a cost of 11.7¢.

The Standard Conversion Heating System for the same test period used 1283.3 m^3 of natural gas through a period of 1755.6 degree days.

The results from the test period shows that the Standard Conversion Unit used 25,803 BTU/Degree Day at a cost of 15.4¢.

From the calculations on page 5, a comparison of the High Efficiency Pulse Boiler results to the Standard Conversion Unit shows that the High Efficiency unit is 23.26% more efficient and would provide fuel cost savings of 24.03%.

3.1 North Bay - Site I

From data collected from test site # 1, 751 Jane Street, the following was deduced for the February 5th, 1982 to the April 28th, 1983 test period of the High Efficiency Pulse Gas Fired Boiler.

Gas Consumption of 1314.6 m^3 in 2343.7 ^{o} Days

1314.6 m^3 X 35,300 BTU/m^3 = 46.41 X 10^6 BTU

$$\frac{46.41 \times 10^6 \text{ BTU}}{2343.7 \ ^o \text{ Days}} = 19802 \text{ BTU}/^o\text{Day}$$

35,300 BTU cost 21.4¢

Therefore, 19802 BTU/^{o}Day cost 11.7¢

High Efficiency operating fuel cost is 11.7¢/^{o}Day

From data collected from test site # 1, 751 Jane Street, the following was deduced for the February 5th, 1982 to the April 28th, 1983 test period of the Standard Gas Fired Equipment.

Standard Unit Gas Consumption 1283.3 m^3 in 1755.6 ^{o} Days

1283.3 m^3 X 35,300 BTU/m^3 = 45.30 X 10^6 BTU

$$\frac{45.30 \times 10^6 \text{ BTU}}{1755.6 \ ^o \text{ Days}} = 25803 \text{ BTU}/^o\text{Day}$$

35,300 BTU cost 21.4¢

25803 BTU/^{o}Day cost 15.4¢/^{o}Day

The Standard Gas Conversion operation fuel cost is 15.4¢/^{o}Day

3.1 North Bay - Site I

A comparison of the High Efficiency Pulse Boiler to the Standard Gas Conversion shows:

$$\frac{25803\ \text{BTU}/^{\circ}\text{Day} - 19802\ \text{BTU}/^{\circ}\text{Day}}{25803\ \text{BTU}/^{\circ}\text{Day}} \times 100 = 23.26\%$$

Therefore, High Efficiency is 23.26% more efficient than Standard Conversion.

$$\frac{15.4¢/^{\circ}\text{Day} - 11.7¢/^{\circ}\text{Day}}{15/4¢/^{\circ}\text{Day}} \times 100 = 24.03\%$$

The High Efficiency would save 24.03%.

NORTH BAY, ONTARIO # 1

FUEL CONSUMPTION COMPARISON
751 JANE ST.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Feb. 05/82 5:15 p.m. to Feb. 12/82 5:15 p.m.	High Efficiency	254	37.6		104.8	187.8
Feb. 12/82 5:15 p.m. to Feb. 19/82 6:40 p.m.	Standard Gas Conversion	348	27.6		104.8	132.7
Feb. 19/82 6:40 p.m. to Feb. 26/82 6:25 p.m.	High Efficiency	268	31.3		87.8	148.2
Feb. 26/82 6:25 p.m. to Mar. 05/82 6:35 p.m.	Standard Gas Conversion	353	32.8		121.8	178.1
Mar. 05/82 6:35 p.m. to Mar. 12/82 5:40 p.m.	High Efficiency	285	34.1		93.5	139.2
Mar. 12/82 5:40 p.m. to Mar. 19/82 5:35 p.m.	Standard Gas Conversion	190	17.3		68.0	95.1
Sept. 19/82 9:00 p.m. to Sept. 26/82 4:00 p.m.	High Efficiency	15	1.1		11.3	21.8
Sept. 26/82 4:00 p.m. to Oct. 03/82 6:20 p.m.	Standard Gas Conversion	17	1.4		5.7	21.5
Oct. 03/82 6:20 p.m. to Oct. 10/82 5:00 p.m.	High Efficiency	24	1.9		5.7	32.2
Oct. 10/82 5:00 p.m. to Oct. 16/82 1:00 p.m.	Standard Gas Conversion	51	4.1		22.7	55.6
Oct. 16/82 1:00 p.m. to Oct. 24/82 6:00 p.m.	High Efficiency	163	15.9		39.7	76.4
Oct. 24/82 6:00 p.m. to Oct. 30/82 1:00 p.m.	Standard Gas Conversion	87	5.4		22.7	37.7

NORTH BAY, ONTARIO # 1

FUEL CONSUMPTION COMPARISON
751 JANE ST.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Oct. 30/82 1:00 p.m. to Nov. 05/82 5:00 p.m.	High Efficiency	69	22.2		19.8	55.0
Nov. 05/82 5:00 p.m. to Nov. 12/82 5:00 p.m.	Standard Gas Conversion	270	15.3		28.3	82.0
Nov. 12/82 5:00 p.m. to Nov. 19/82 4:00 p.m.	High Efficiency	229	22.2		87.8	102.0
Nov. 19/82 4:00 p.m. to Nov. 26/82 5:30 p.m.	Standard Gas Conversion	222	15.5		59.5	116.4
Nov. 26/82 5:30 p.m. to Dec. 03/82 6:30 p.m.	High Efficiency	198	22.0		56.7	84.3
Dec. 03/82 6:30 p.m. to Dec. 10/82 6:30 p.m.	Standard Gas Conversion	238	20.6		79.3	142.3
Dec. 10/82 6:30 p.m. to Dec. 17/82 5:30 p.m.	High Efficiency	286	37.1		99.2	183.6
Dec. 17/82 5:30 p.m. to Dec. 23/82 12:00 a.m.	Standard Gas Conversion	348	22.5		85.0	125.2
Dec. 23/82 12:00 a.m. to Dec. 31/82 5:00 p.m.	High Efficiency	338	31.9		82.2	125.9
Dec. 31/82 5:00 p.m. to Jan. 07/83 4:45 p.m.	Standard Gas Conversion	281	23.1		90.6	150.6
Jan. 07/83 4:45 p.m. to Jan. 14/83 5:30 p.m.	High Efficiency	266	37.1		93.5	190.7
Jan. 14/83 5:30 p.m. to Jan. 21/83 8:00 p.m.	Standard Gas Conversion	484	39.8		147.3	246.3

NORTH BAY, ONTARIO # 1

FUEL CONSUMPTION COMPARISON
751 JANE ST.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	CONSUMPTION ^{0} DAYS
Jan. 21/83 8:00 p.m. to Jan. 28/83 5:00 p.m.	High Efficiency	275	33.3		87.8	190.0
Jan. 28/83 5:00 p.m. to Feb. 04/83 9:30 a.m.	Standard Gas Conversion	290	22.2		87.8	194.4
Feb. 04/83 9:30 a.m. to Feb. 11/83 5:30 p.m.	High Efficiency	345	47.7		121.8	224.2
Feb. 11/83 5:30 p.m. to Feb. 18/83 5:00 p.m.	Standard Gas Conversion	362	24.4		93.5	116.8
Feb. 18/83 5:00 p.m. to Feb. 25/83 5:00 p.m.	High Efficiency	206	26.4		68.0	118.5
Feb. 25/83 5:00 p.m. to Mar. 04/83 5:20 p.m.	Standard Gas Conversion	215	16.4		65.2	92.5
Mar. 04/83 5:20 p.m. to Mar. 12/83 11:00 a.m.	High Efficiency	221	25.7		62.3	109.1
Mar. 12/83 11:00 a.m. to Mar. 18/83 4:45 p.m.	Standard Gas Conversion	164	12.4		53.8	60.0
Mar. 18/83 4:45 p.m. to Mar. 25/83 5:30 p.m.	High Efficiency	271	31.9		85.0	156.0
Mar. 25/83 5:30 p.m. to Apr. 01/83 4:15 p.m.	Standard Gas Conversion	328	20.2		79.3	105.8
Apr. 01/83 4:15 p.m. to Apr. 08/83 5:20 p.m.	High Efficiency	172	17.2		42.49	99.4
Apr. 08/83 5:20 p.m. to Apr. 15/83 5:00 p.m.	Standard Gas Conversion	164	12.0		48.2	65.1

NORTH BAY, ONTARIO # 1

FUEL CONSUMPTION COMPARISON
751 JANE ST.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M)	^{o} DAYS
Apr. 15/83 5:00 p.m. to Apr. 23/83 1:00 p.m.	High Efficiency	237	25.2		65.2	99.4
Apr. 23/83 1:00 p.m. to Apr. 26/83 3:00 p.m.	Standard Gas Conversion	54	4.3		19.8	22.1

3.2 North Bay - Site II

The test results for the period February 12th, 1982 to June 10th, 1983 shows that the High Efficiency Condensing Furnace used 1498.7 m^3 of natural gas through a period of 2343.7 Degree Days.

The average BTU content per m^3 is 35,300 BTU at a cost of 21.4¢.

The aforementioned results from the test period show that the High Efficiency System used 18482 BTU/^{o}Day at a cost of 11.2¢.

The Standard Oil Heating Furnace for the same test period used 1193.2 litres of # 2 oil through a degree day period of 2063.8.

The average BTU content per litre is 36,730 BTU's at a cost of 33.9¢.

The results from the test period shows that the Standard Oil Unit used 21238 BTU/^{o}Day at a cost of 20.8¢.

A comparison of the High Efficiency Condensing Furnace results to the Standard Conversion Unit shows the High Efficiency Unit is 13% more efficient and would show cost savings of 46.2% over the Standard Oil Unit.

3.2 North Bay - Site II

From the data collected at test site # 2, 848 Pinewood Road, the following was deduced for the February 12th, 1982 through the June 10th, 1983 test period of the High Efficiency Condendsing Unit.

Gas Consumption of 1498.7 m^3 in 2862.3 ^{o} Days

1498.7 m^3 X 35,300 BTU/m^3 = 52.90 X 10^6 BTU

$$\frac{52.90 \times 10^6 \text{ BTU}}{2862.3 \ ^{o} \text{ Days}} = 18482 \text{ BTU}/^{o}\text{Day}$$

35,300 BTU cost 21.4¢

Therefore, 18482 BTU/^{o}Days cost 11.2¢

High Efficiency operating fuel cost is 11.2¢/^{o}Day

From the data collected from test site # 2, 848 Pinewood Road, the following was deduced for the February 12th, 1982 through the June 10th, 1983 test period of the Oil Test Unit.

Oil Consumption of 1193.2 litres in 2063.8 ^{o} Days

1193.2 litres X 36730 BTU/litre = 43.83 X 10^6

$$\frac{43.83 \times 10^6 \text{ BTU}}{2063.8 \ ^{o} \text{ Days}} = 21238 \text{ BTU}/^{o}\text{Day}$$

36730 BTU cost 33.9¢

Therefore 21238 BTU/^{o}Day cost 20.8¢

The Oil Furnace's operating fuel cost is 20.8¢/^{o}Day.

3.2 Nor Bay - Site II

A comparison of the High Efficiency Condensing Furnace to the Standard Oil Furnace shows the High Efficiency Furnace is

$$\frac{21238\ \text{BTU}/^{\circ}\text{Day} - 18482\ \text{BTU}/^{\circ}\text{Day}}{21238\ \text{BTU}/^{\circ}\text{Day}} \times 100 = 13\%\ \text{more efficient}$$

It would also save $\frac{20.8¢/^{\circ}\text{Day} - 11.2¢/^{\circ}\text{Day}}{20.8¢/^{\circ}\text{Day}} \times 100 = 46.2\%$ savings

NORTH BAY, ONTARIO # 2

FUEL CONSUMPTION COMPARISON
848 PINEWOOD RD.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME (HOURS)	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Feb. 12/82 7:00 p.m. to Feb. 19/82 6:00 p.m.	High Efficiency	211	42.0		82.2	132.7
Feb. 19/82 6:00 p.m. to Feb. 22/82 10:30 a.m.	Oil Furnace	101	6.4	17.7		42.9
Feb. 22/82 10:30 a.m. to Mar. 13/82 11:00 a.m.	High Efficiency	651	119.8		235.1	437.6
Mar. 13/82 11:00 a.m. to Mar. 20/82 1:00 p.m.	Oil Furnace	339	21.1	57.7		92.8
Mar. 20/82 1:00 p.m. to Apr. 01/82 5:00 p.m.	High Efficiency	203	51.6		102.0	187.6
Apr. 01/82 5:00 p.m. to Apr. 08/82 5:15 p.m.	Oil Furnace	406	28.4	77.7		143.2
Apr. 08/82 5:15 p.m. to Apr. 15/82 6:00 p.m.	High Efficiency	91	22.2		45.3	79.0
Apr. 15/82 6:00 p.m. to Apr. 23/82 8:00 a.m.	Oil Furnace	267	17.3	48.5		94.5
Apr. 23/82 8:00 a.m. to Apr. 27/82 6:00 p.m.	High Efficiency	44	10.8		19.8	2.7
Apr. 27/82 6:00 p.m. to May 06/82 6:00 p.m.	Oil Furnace	28	2.5	7.0		19.1
May 06/82 6:00 p.m. to May 13/82 6:00 p.m.	High Efficiency	3	0.7		2.8	14.4
May 13/82 6:00 p.m.	Oil Furnace	1	0.1	.23		0

NORTH BAY, ONTARIO # 2

FUEL CONSUMPTION COMPARISON
848 PINEWOOD RD.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	o Days
Sept. 17/82 6:00 p.m. to Sept. 25/82 12:00 p.m.	High Efficiency	43	8.0		17.0	35.6
Sept. 25/82 12:00 p.m. to Oct. 02/82 6:00 p.m.	Oil Furnace	16	1.5	4.37		18.3
Oct. 02/82 6:00 p.m. to Oct. 09/82 9:00 a.m.	High Efficiency	15	3.0		5.7	28.7
Oct. 09/82 9:00 a.m. to Oct. 16/82 11:00 a.m.	Oil Furnace	61	7.3	20.4		62.9
Oct. 16/82 11:00 a.m. to Oct. 23/82 11:00 a.m.	High Efficiency	84	15.8		28.3	68.1
Oct. 23/82 11:00 a.m. to Oct. 30/82 11:00 a.m.	Oil Furnace	72	8.7	24.3		46.0
Oct. 30/82 11:00 a.m. to Nov. 13/82 11:00 a.m.	High Efficiency	197	38.0		76.5	158.0
Nov. 13/82 11:00 a.m. to Nov. 27/82 11:00 a.m.	Oil Furnace	342	42.7	118.5		221.9
Nov. 27/82 11:00 a.m. to Dec. 04/82 11:00 a.m.	High Efficiency	130	25.4		51.0	72.9
Dec. 04/82 11:00 a.m. to Dec. 11/82 8:30 a.m.	Oil Furnace	217	30.6	84.7		161.9
Dec. 11/82 8:30 a.m. to Dec. 18/82 11:00 a.m.	High Efficiency	312	51.8		99.2	171.1
Dec. 18/82 11:00 a.m. to Jan. 01/83 12:00 p.m.	Oil Furnace	674	71.1	186.3		249.4

NORTH BAY, ONTARIO # 2

FUEL CONSUMPTION COMPARISON
848 PINEWOOD RD.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Jan. 01/83 12:00 p.m. to Jan. 15/83 11:00 a.m.	High Efficiency	402	83.5		167.1	358.3
Jan. 15/83 11:00 a.m. to Jan. 29/83 10:00 a.m.	Oil Furnace	507	76.9	196.3		421.8
Jan. 29/83 10:00 a.m. to Feb. 12/83 10:00 a.m.	High Efficiency	333	94.8		189.8	420.7
Feb. 12/83 10:00 a.m. to Feb. 15/83 10:00 a.m.	Oil Furnace	211	27.7	70.6		45.8
Feb. 15/83 10:00 a.m. to Feb. 26/83 10:00 a.m.	High Efficiency	122	32.3		65.2	185.4
Feb. 26/83 10:00 a.m. to Mar. 05/83 8:00 a.m.	Oil Furnace	151	20.1	51.0		81.9
Mar. 05/83 8:00 a.m. to Mar. 12/83 8:00 a.m.	High Efficiency	123	30.8		59.5	100.2
Mar. 12/83 8:00 a.m. to Mar. 19/83 11:00 a.m.	Oil Furnace	149	15.2	39.0		73.8
Mar. 19/83 11:00 a.m. to Mar. 26/83 10:00 a.m.	High Efficiency	161	47.4		99.2	156.7
Mar. 26/83 10:00 a.m. to Apr. 09/83 9:30 a.m.	Oil Furnace	365	43.7	111.5		170.2
Apr. 09/83 9:30 a.m. to Apr. 23/83 9:30 a.m.	High Efficiency	223	51.9		102.0	158.0
Apr. 23/83 9:30 a.m. to Apr. 30/83 10:00 a.m.	Oil Furnace	77	9.4	24.3		40.0

NORTH BAY, ONTARIO # 2

FUEL CONSUMPTION COMPARISON
848 PINEWOOD RD.
NORTH BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Apr. 30/83 10:00 a.m. to May 07/83 10:00 a.m.	High Efficiency	58	14.4		31.2	53.9
May 07/83 10:00 a.m. to May 14/83 10:00 a.m.	Oil Furnace	94	11.0	28.3		28.1
May 14/83 10:00 a.m. to May 21/83 10:00 a.m.	High Efficiency	36	8.4		17.0	34.8
May 21/83 10:00 a.m. to May 28/83 10:00 a.m.	Oil Furnace	57	7.4	18.9		34.8
May 28/83 10:00 a.m. to June 03/83 10:00 a.m.	High Efficiency	9	2.3		2.8	5.9
June 03/83 10:00 a.m. to June 10/83 10:00 a.m.	Oil Furnace	14	2.3	5.9		14.5

3.3 Thunder Bay - Site III

The test results for the period January 29th, 1982 to May 16th, 1983 shows that the High Efficiency Forced Air Condensate Furnace used 2022.6 m^3 of natural gas through a period of 4838.5 Degree Days.

The average BTU content per m^3 is 35,300 BTU at a cost of 21.4¢.

The aforementioned results from the test period show the High Efficiency System used 14,757 BTU/^{o}Day at a cost of 8.95¢.

The Standard Conversion Gas Unit for the same test period used 1417.7 m^3 through a period of 2649.9 Degree Days.

The results of this period show that the Standard Unit used 13888 BTU/^{o}Day at a cost of 11.4¢.

A comparison of the High Efficiency Condensate Furnace results to the Standard Conversion Unit show the High Efficiency Unit is 21.9% more efficient and would show overall fuel cost savings of 21.5% over the Standard Unit.

3.3 Thunder Bay - Site III

From the data collected from test site # 3, Thunder Bay, the following was deduced for the January 29th, 1982 through the May 16th, 1983 test period of the High Efficiency Condensing Unit.

Gas Consumption 2022.6 m^3 in 4838.5 ^{o} Days

2022.6 m^3 X 35,300 BTU/m^3 = 71.40 X 10^6 BTU

$$\frac{71.40 \times 10^6 \text{ BTU}}{4838.5 \ ^{o} \text{ Days}} = 14757 \text{ BTU}/^{o}\text{Day}$$

35,300 BTU cost 21.4¢

Therefore, 14757 BTU/^{o}Day cost 8.95¢

High Efficiency operating fuel cost is 8.95¢/^{o}Day

From the data collected at test site # 3, Thunder Bay, Ont., the following was deduced for the January 29th, 1982 through the May 16th, 1983 test period of the Standard Forced Air Gas Furnace.

Gas Consumption 1417.7 m^3 in 2649.9 ^{o} Days

1417.7 m^3 X 35,300 BTU/m^3 = 50.05 X 10^6 BTU

$$\frac{50.05 \times 10^6 \text{ BTU}}{26499 \ ^{o} \text{ Day}} = 18888 \text{ BTU}/^{o}\text{Day}$$

35,300 BTU cost 21.4¢

Therefore, 18888 BTU/^{o}Day cost 11.4¢

The Standard Conversion Furnace operating fuel cost is 11.4¢/^{o}Day.

3.3 Thunder Bay - Site III

A comparison of the High Efficiency Furnace to the Standard Conversion Gas Furnace shows that the High Efficiency Furnace is

$$\frac{18{,}888\ \text{BTU}/^{\circ}\text{Day} - 14{,}757\ \text{BTU}/^{\circ}\text{Day}}{18{,}888\ \text{BTU}/^{\circ}\text{Day}} \times 100 = 21.9\%\ \text{more efficient}$$

and would produce overall savings of

$$\frac{11.4¢/^{\circ}\text{Day} - 8.95¢/^{\circ}\text{Day}}{11.4¢/^{\circ}\text{Day}} \times 100 = 21.5\%$$

THUNDER BAY, ONTARIO

FUEL CONSUMPTION COMPARISON

THUNDER BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	o DAYS
Jan. 29/82 10:00 a.m. to Feb. 21/82 10:00 a.m.	High Efficiency	417	149.4		317.3	787.7
Feb. 21/82 10:00 a.m. to Feb. 28/82 10:00 a.m.	High Efficiency	32	33.2		70.8	213.6
Feb. 28/82 10:00 a.m. to Mar. 07/82 10:00 a.m.	High Efficiency	47	62.1		119.0	241.0
Mar. 07/82 10:00 a.m. to Mar. 15/82 10:00 a.m.	Standard Gas Conversion	44	43.6		144.5	200.5
Mar. 15/82 10:00 a.m. to Mar. 22/82 10:00 a.m.	High Efficiency	26	25.0		25.5	149.2
Mar. 22/82 10:00 a.m. to Mar. 29/82 10:00 a.m.	Standard Gas Conversion	26	23.4		109.7	160.1
Mar. 29/82 10:00 a.m. to Apr. 05/82 10:00 a.m.	High Efficiency	42	34.2		70.8	172.9
Apr. 05/82 10:00 a.m. to Apr. 11/82 10:00 a.m.	Standard Gas Conversion	18	20.5		48.2	127.4
Apr. 11/82 10:00 a.m. to Apr. 18/82 10:00 a.m.	High Efficiency	25	21.6		48.2	117.3
Apr. 18/82 10:00 a.m. to Apr. 25/82 10:00 a.m.	Standard Gas Conversion	19	13.8		70.8	101.8
Apr. 25/82 10:00 a.m. to May 09/82 10:00 a.m.	High Efficiency	27	20.4		42.5	155.9
May 09/82 10:00 a.m. to May 17/82 10:00 a.m.	Standard Gas Conversion	18	13.1		45.3	62.9

FUEL CONSUMPTION COMPARISON

THUNDER BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
May 17/82 10:00 a.m. to May 31/82 10:00 a.m.	High Efficiency	18	13.1		11.3	67.9
Oct. 17/82 10:00 a.m. to Oct. 24/82 10:00 a.m.	Standard Gas Conversion	17	33.0		56.7	118.1
Oct. 24/82 10:00 a.m. to Nov. 07/82 10:00 a.m.	High Efficiency	43	41.4		87.8	228.4
Nov. 07/82 10:00 a.m. to Nov. 15/82 10:00	Standard Gas Conversion	22	69.4		116.1	201.7
Nov. 15/82 10:00 a.m. to Nov. 23/82 10:00 a.m.	High Efficiency	30	33.1		70.8	175.8
Nov. 23/82 10:00 a.m. to Nov. 29/82 10:00 a.m.	Standard Gas Conversion	36	51.5		127.5	179.0
Nov. 29/82 10:00 a.m. to Dec. 13/82 10:00 a.m.	High Efficiency	71	79.0		138.8	362.5
Dec. 13/82 10:00 a.m. to Dec. 25/82 10:00 a.m.	Standard Gas Conversion	88	61.7		204.0	298.5
Dec. 25/82 10:00 a.m. to Jan. 11/83 10:00 a.m.	High Efficiency	100	108.2		258.0	509.3
Jan. 11/83 10:00 a.m. to Jan. 25/83 10:00 a.m.	Standard Gas Conversion	95	78.4		240.8	468.2
Jan. 25/83 10:00 a.m. to Feb. 01/83 10:00 a.m.	High Efficiency	46	45.1		93.5	208.0
Feb. 01/83 10:00 a.m. to Feb. 08/83 10:00 a.m.	Standard Gas Conversion	58	49.5		144.5	261.9

FUEL CONSUMPTION COMPARISON

THUNDER BAY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION		
				OIL (LITRES)	GAS (M^3)	^{0} DAYS
Feb. 08/83 10:00 a.m. to Mar. 06/83 10:00 a.m.	High Efficiency	143	136.1		288.9	580.5
Mar. 06/83 10:00 a.m. to Mar. 14/83 10:00 a.m.	Standard Gas Conversion	50	43.1		116.1	184.3
Mar. 14/83 10:00 a.m. to Apr. 25/83 10:00 a.m.	High Efficiency	182	181.2		379.6	868.5
Apr. 25/83 10:00 a.m. to May 16/83 10:00 a.m.	Standard Gas Conversion	64	66.5		164.3	285.5

3.4 Sudbury - Site IV

The test results for the period March 8th, 1982 to July 22nd, 1983 shows that the High Efficiency Boiler used 1209 m^3 of natural gas through a period of 1876.1 Degree Days.

The average BTU content per m^3 is 35,300 BTU at a cost of 21.4¢.

The aforementioned results from the test period show the HIgh Efficiency system used 22749 BTU/^{o}Day at a cost of 13.8¢.

The existing Oil Fired System for the same test period used 3699 litres of # 2 oil through a period of 4839.5 Degree Days.

The BTU content per litre is 36,730 BTU's at a cost of 33.9¢.

The results from the test period shows that the Standard Unit used 28073 BTU/^{o}Day at a cost of 25.9¢.

A comparison of the High Efficiency Pulse Boiler to the existing Standard Oil Boiler shows that the High Efficiency Unit is 18.9% more efficient and would show overall cost savings of 46.7%.

3.4 Sudbury - Site IV

From the data collected from test site # 4, 28 Oja St., Sudbury, the following was deduced for the March 8th, 1982 to July 22nd, 1983 test period of the High Efficiency Boiler Unit.

Gas Consumption 1209 m^3 in 1876.1 ^{o} Days

1209 m^3 X 35,000 BTU/m^3 = 42.68 X 10^6 BTU

$$\frac{42.68 \times 10^6 \text{ BTU}}{1876.1 \text{ }^{o} \text{ Days}} = 22749 \text{ BTU/}^{o}\text{Day}$$

35,300 BTU cost 21.4¢

Therefore, 22,749 BTU/^{o}Day cost 13.8¢

High Efficiency operating fuel cost is 13.8¢/^{o}Day

From the data collected at the # 4 test site, 28 Oja St., Sudbury, the following was deduced for the March 8th, 1982 through July 22nd, 1983 test period of the Standard Oil Boiler.

Oil Consumption of 3699 litres in 4839.5 ^{o} Days

3699 litres X 36730 BTU/litre = 135.86 X 10^6 BTU

$$\frac{135.86 \times 10^6 \text{ BTU}}{4839.5 \text{ }^{o} \text{ Days}} = 28073 \text{ BTU/}^{o}\text{Day}$$

36730 BTU cost 33.9¢

Therefore, 28073 BTU/^{o}Day cost 25.9¢

The Oil Furnace's operating fuel cost is 25.9¢/^{o}Day

3.4 Sudbury - Site IV

A comparison of the High Efficiency Pulse Boiler to the Standard Oil Boiler shows the High Efficiency Boiler is

$$\frac{28073\ \text{BTU}/^{o}\text{Day} - 22749\ \text{BTU}/^{o}\text{Day}}{28073\ \text{BTU}/^{o}\text{Day}} \times 100 = 18.9\%\ \text{more efficient}$$

It would also show $\frac{25.9¢/^{o}\text{Day} - 13.8¢/^{o}\text{Day}}{25.9¢/^{o}\text{Day}} \times 100 = 46.7\%$ saving

over the Oil Unit.

SUDBURY, ONTARIO

FUEL CONSUMPTION COMPARISON
28 OJA ST.
SUDBURY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{o} DAYS
Mar. 08/82 1:34 p.m. to Mar. 15/82 4:30 p.m.	High Efficiency	1095	530.0		125.0	256.5
Mar. 15/82 4:30 p.m. to Mar. 22/82 5:15 p.m.	Oil Furnace	596	356.0	142.0		153.4
Mar. 22/82 5:15 p.m. to Mar. 29/82 6:25 p.m.	High Efficiency	1157	328.0		79.0	140.9
Mar. 29/82 6:25 p.m. to Apr. 05/82 4:45 p.m.	Oil Furnace	600	337.0	137.0		165.8
Apr. 05/82 4:45 p.m. to Apr. 19/82 4:55 p.m.	High Efficiency	1096	380.0		93.0	152.3
Apr. 19/82 4:55 p.m. to May 02/82 5:00 p.m.	Oil Furnace	566	538.0	216.0		253.3
May 02/82 5:00 p.m. to May 12/82 8:20 a.m.	High Efficiency	584	407.0		99.0	153.7
May 12/82 8:20 a.m.	Oil Furnace	54	62.0	22.0		59.4
Feb. 12/83 7:00 p.m. to Feb. 26/83 12:00 p.m.	Oil Furnace	7015	6429.0	2400.0		3405.5
Feb. 26/83 12:00 p.m. to Mar. 07/83 6:30 p.m.	High Efficiency	1165	892.0		227.0	358.6
Mar. 07/83 6:30 p.m. to Mar. 14/83 8:30 p.m.	Oil Furnace	352	384.0	158.0		162.4
Mar. 14/83 8:30 p.m. to Mar. 22/83 6:30 p.m.	High Efficiency	594	452.0		113.0	145.8

SUDBURY, ONTARIO

FUEL CONSUMPTION COMPARISON
28 OJA ST.
SUDBURY, ONTARIO

BI-WEEKLY TEST PERIOD	APPLIANCE	NUMBER OF EVENTS	ELAPSED TIME	CONSUMPTION OIL (LITRES)	CONSUMPTION GAS (M^3)	^{0} DAYS
Mar. 22/83 6:30 p.m. to Mar. 28/83 8:00 p.m.	Oil Furnace	377	425.0	176.0		187.4
Mar. 28/83 8:00 p.m. to Apr. 04/83 8:15 p.m.	High Efficiency	575	46.4		116.0	161.6
Apr. 04/83 8:15 p.m. to Apr. 11/83 8:30 p.m.	Oil Furnace	264	315.0	130.0		136.8
Apr. 11/83 8:30 p.m. to Apr. 19/83 8:00 p.m.	High Efficiency	565	340.0		82.0	110.2
Apr. 19/83 8:00 p.m. to May 03/83 7:10 p.m.	Oil Furnace	302	346.0	141.0		144.6
May 03/83 7:10 p.m. to May 09/83 6:55 p.m.	High Efficiency	823	521.0		133.0	183.9
May 09/83 6:55 p.m. to May 16/83 9:25 p.m.	Oil Furnace	155	191.0	79.0		87.9
May 16/83 9:25 p.m. to May 23/83 10:05 p.m.	High Efficiency	231	156.0		37.0	56.3
May 23/83 10:05 p.m. to June 27/83 4:45 p.m.	Oil Furnace	101	151.0	62.0		64.4
June 27/83 4:45 p.m. to July 22/83 12:00 p.m.	High Efficiency	624	416.0		105.0	156.3
July 22/83 12:00 p.m.	Oil Furnace	42	89.0	36.0		18.6

INSTALLATION COST V.S. PAYBACK

4.1 North Bay - Site I

High Efficiency Pulse Boiler installation would cost $2,832.50.

From the results of the tests, the savings of the High Efficiency Pulse Boiler to the Standard Conversion Unit would be $151.67 which makes the payback on this system approximately 18.7 years.

4.2 North Bay - Site II

The fuel operating costs comparing the High Efficiency Condensing Unit to the Standard Oil Unit show the High Efficiency Unit would save 46.2% on fuel costs.

The installation cost for the High Efficiency Unit was $2,167.55. The saving at this site would be $472.90 which would offer a payback to the installation cost of 4.6 years.

If the Federal Government's off oil grant is applied to the cost of the equipment, the payback for the installation can be reduced to 2.9 years.

4.3 Thunder Bay - Site III

The comparison of the High Efficiency Unit to the Standard Forced Air Gas System shows overall savings of 21.5% in fuel costs.

The cost of this installation was $2,267.55. The cost savings would be $171.22. The payback on this installation would be 13.2 years.

4.4 Sudbury - Site IV

The comparison of the High Efficiency Pulse Boiler to the Standard Oil Unit shows fuel operating cost savings of 46.7%.

The cost of the installation was $2,982.50. The cost savings would be $812.60. The payback of the High Efficiency installation would be 3.7 years.

If the Federal Government's off oil grant (C.O.S.P.) is applied to the installation, the payback period can be reduced to 2.7 years.

CONCLUSION

The results from all four test sites show that the High Efficiency Units, in a general comparison to the less efficient test units or Oil Units are more effective as well as provide substantial opportunity for operational cost savings.